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(54) Increasing keyboard functions by depressing a plurality of keys simultaneously

(57) A key board has a geometric arrangement having intersections of three keys achieved by offsetting or staggering adjacent keys. This provides a greater number of choices from a given number of keys actuatable manually one, two or three at a time. The key layout permits touch typing with one hand where twelve keys provides full alphanumeric capabilities. Finger positions conform with human hand structure and include raised ridges for identifying some of the fingerstroke key

selection locations. Thus, accurate high speed typing with either hand is feasible in a telephone dial space frame. The keyboard communicates by an X by Y communication channel matrix or telephone system compatible tone signals with computers, telephones, teletypes and like utility devices. Program steps and function selection is afforded by a self cataloged two (or more) keystroke sequence to reduce programming time and increase the number of selections possible per key. Thus, as few as four keys and four wires can afford fourteen manual selections by a single fingerstroke in a single live key mode.

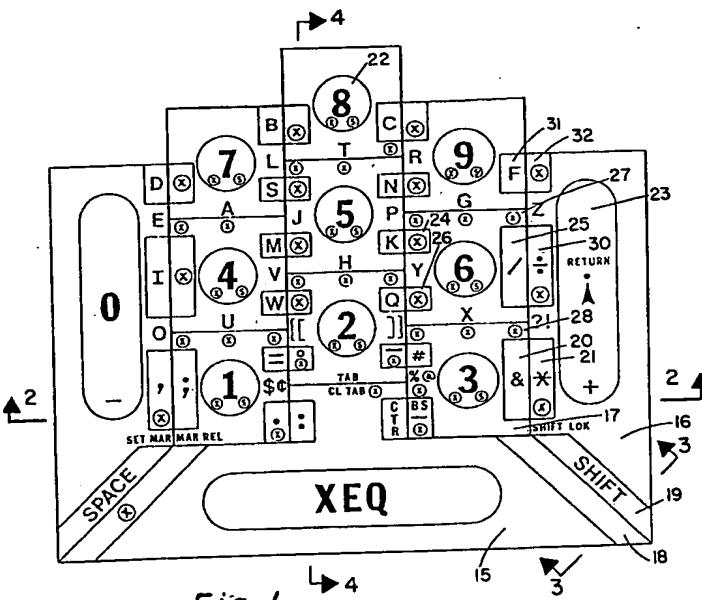


Fig. 1

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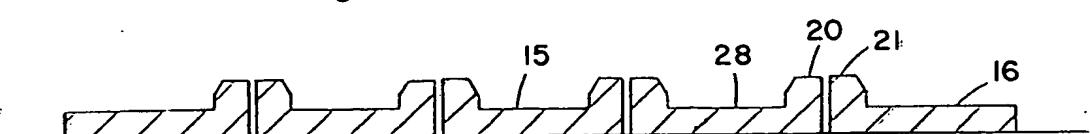
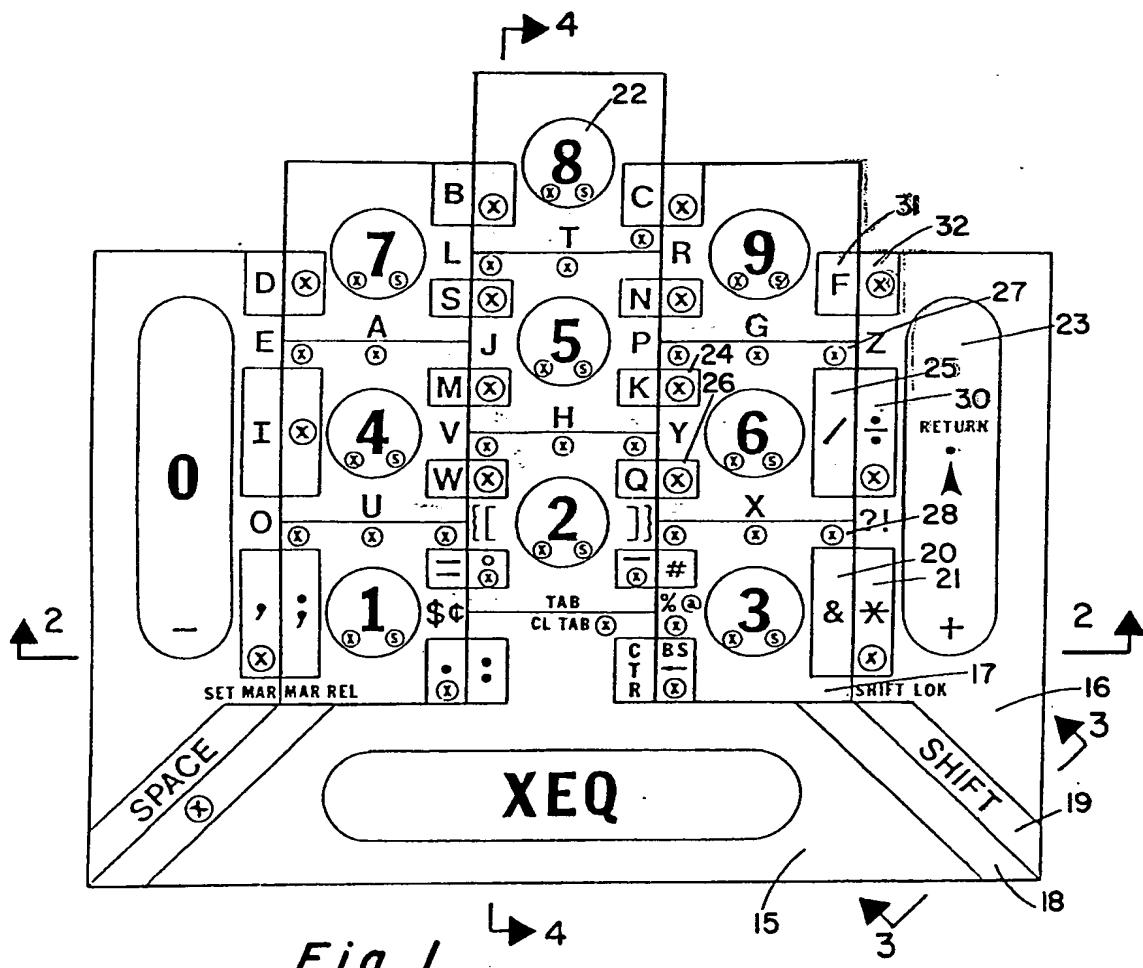


Fig. 2

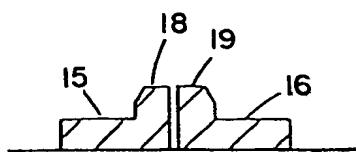


Fig. 3

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SINGLE FINGER DEPRESSES KEYS: XEQ, 1 & 2

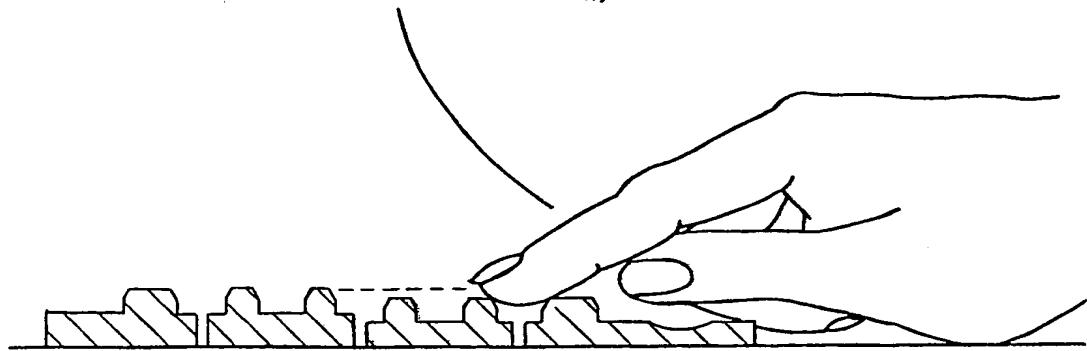


Fig. 4

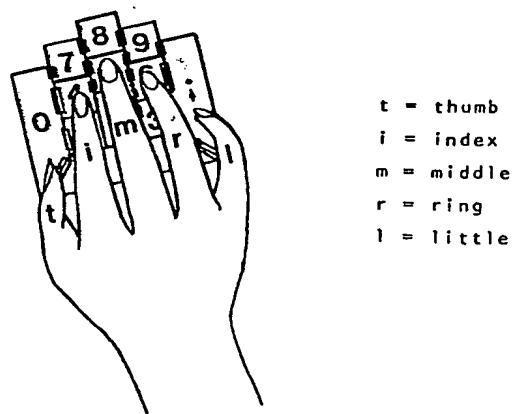


Fig. 4A

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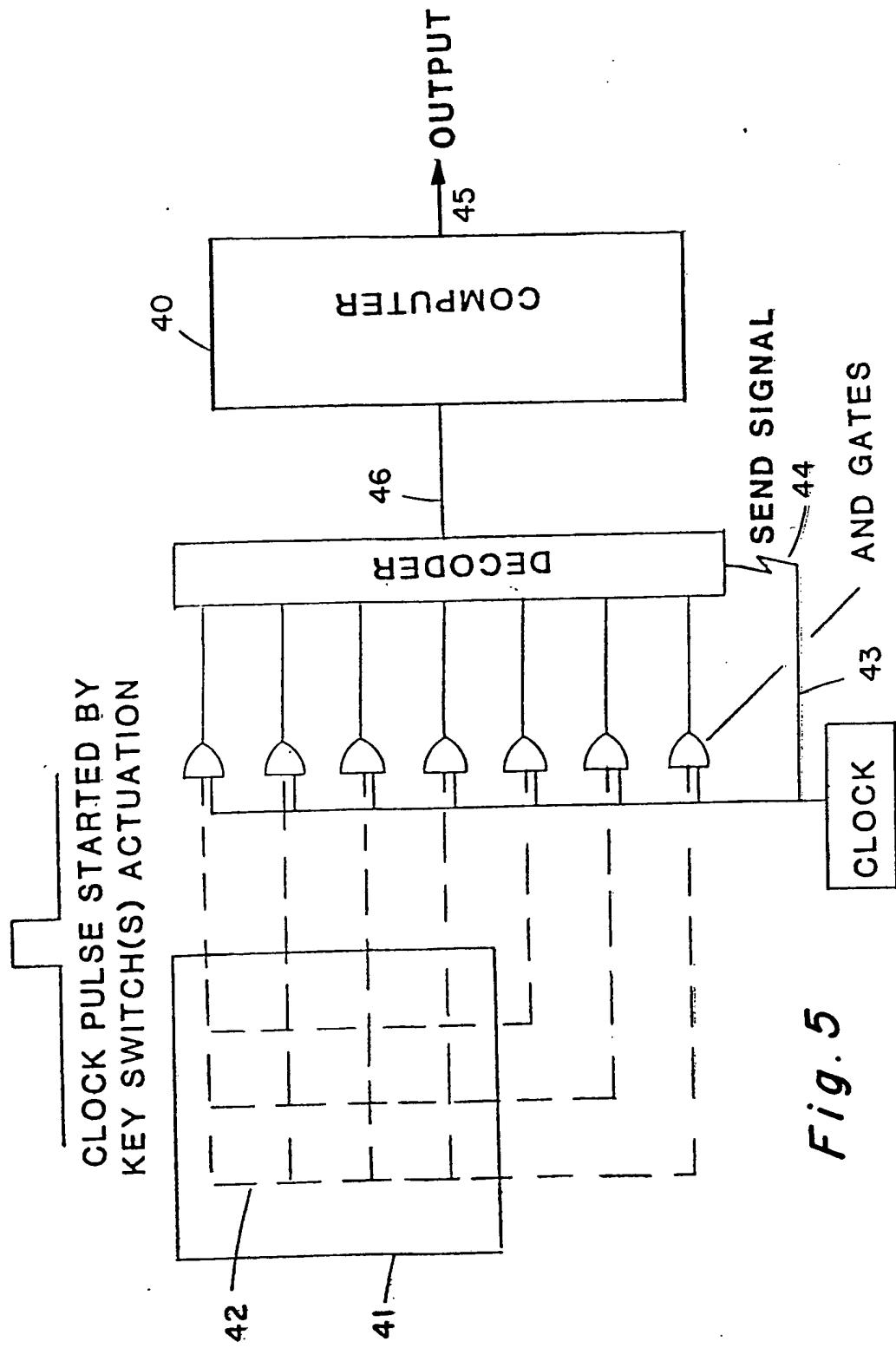


Fig. 5

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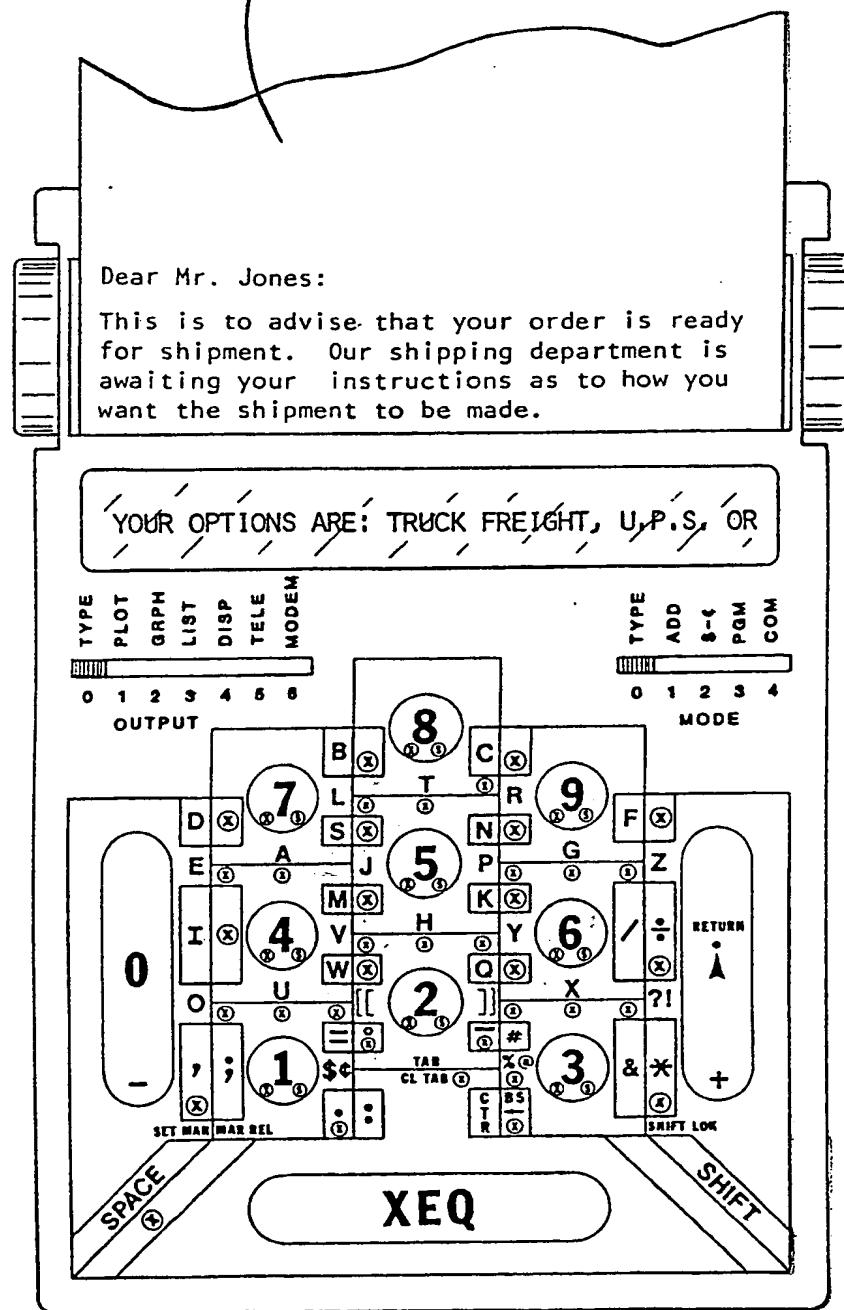


Fig.7

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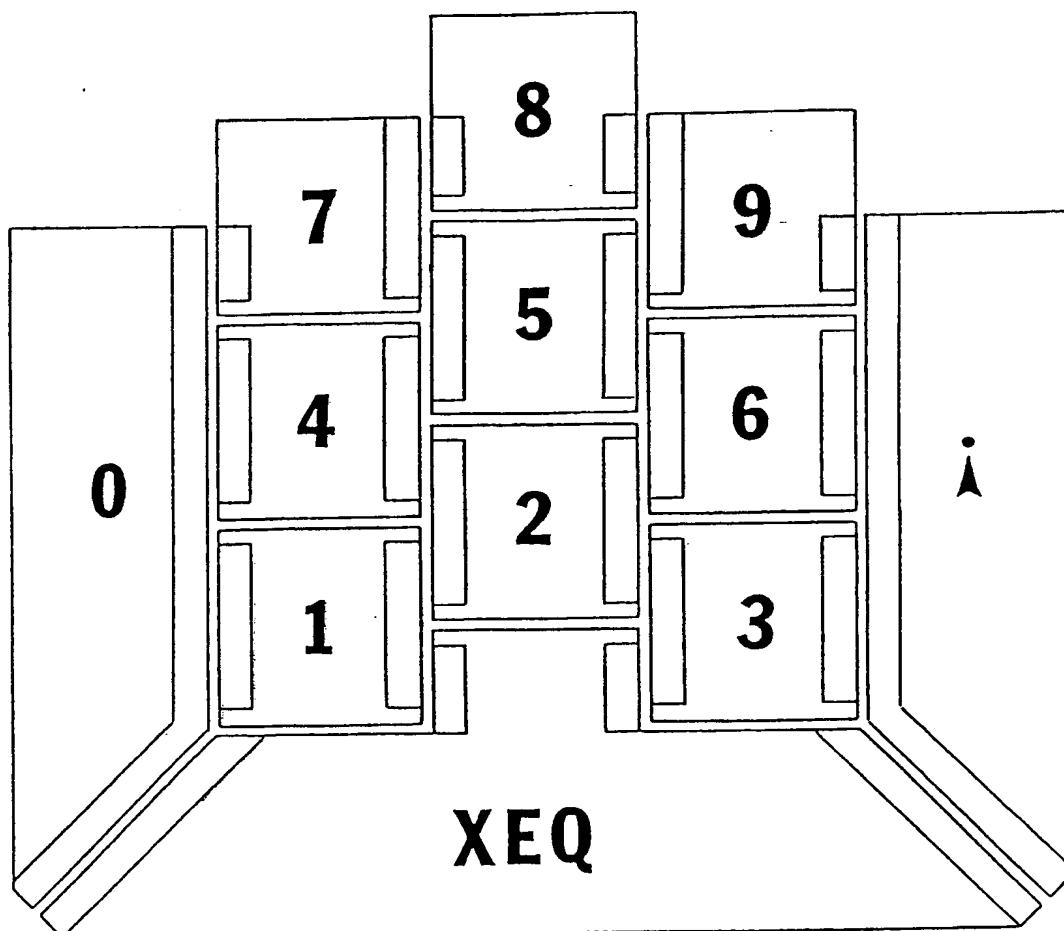


Fig. 8

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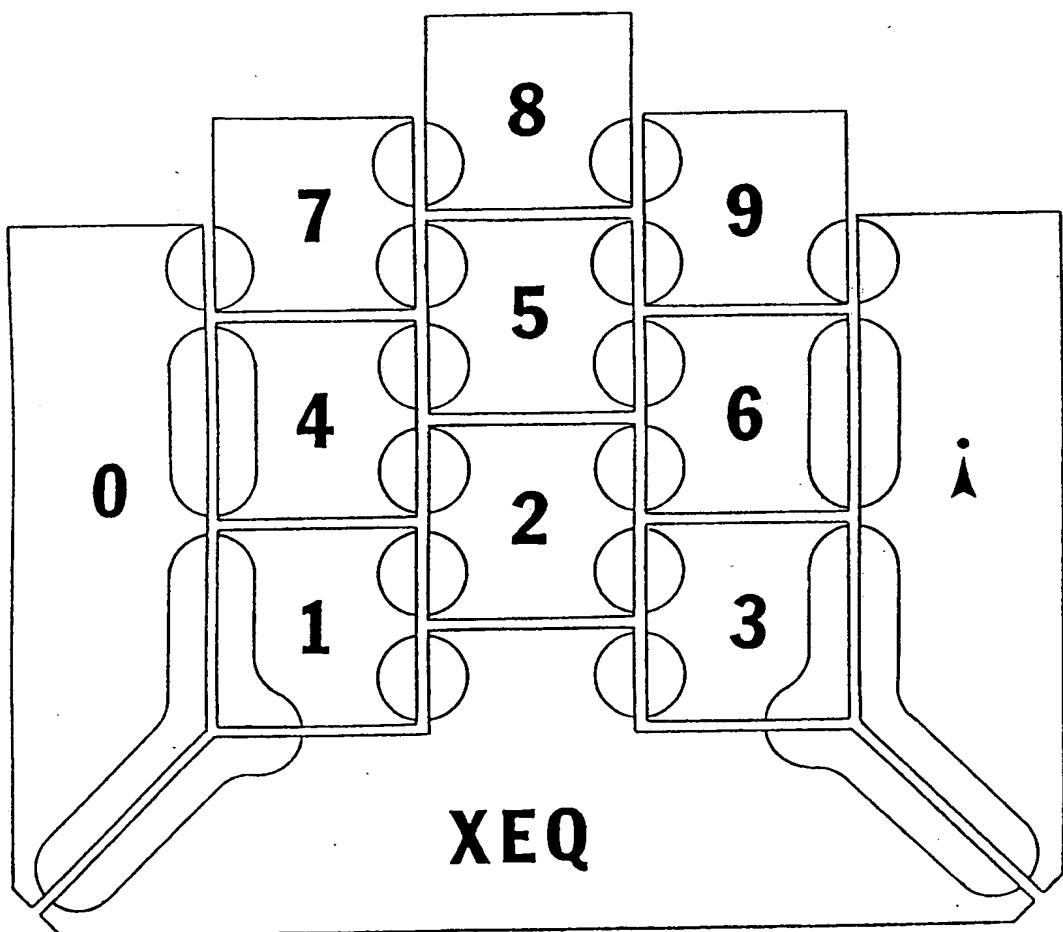


Fig. 9

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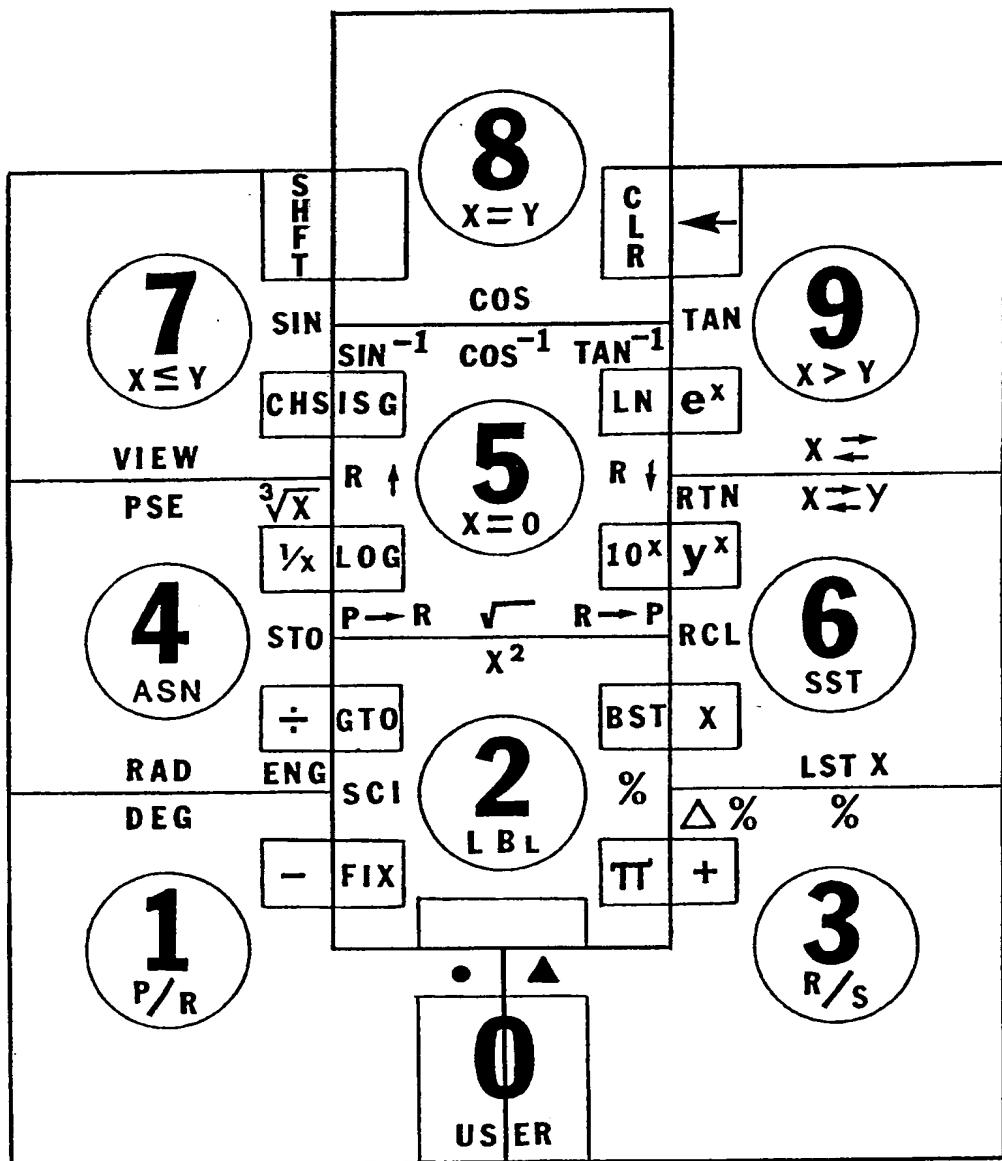


Fig. 10

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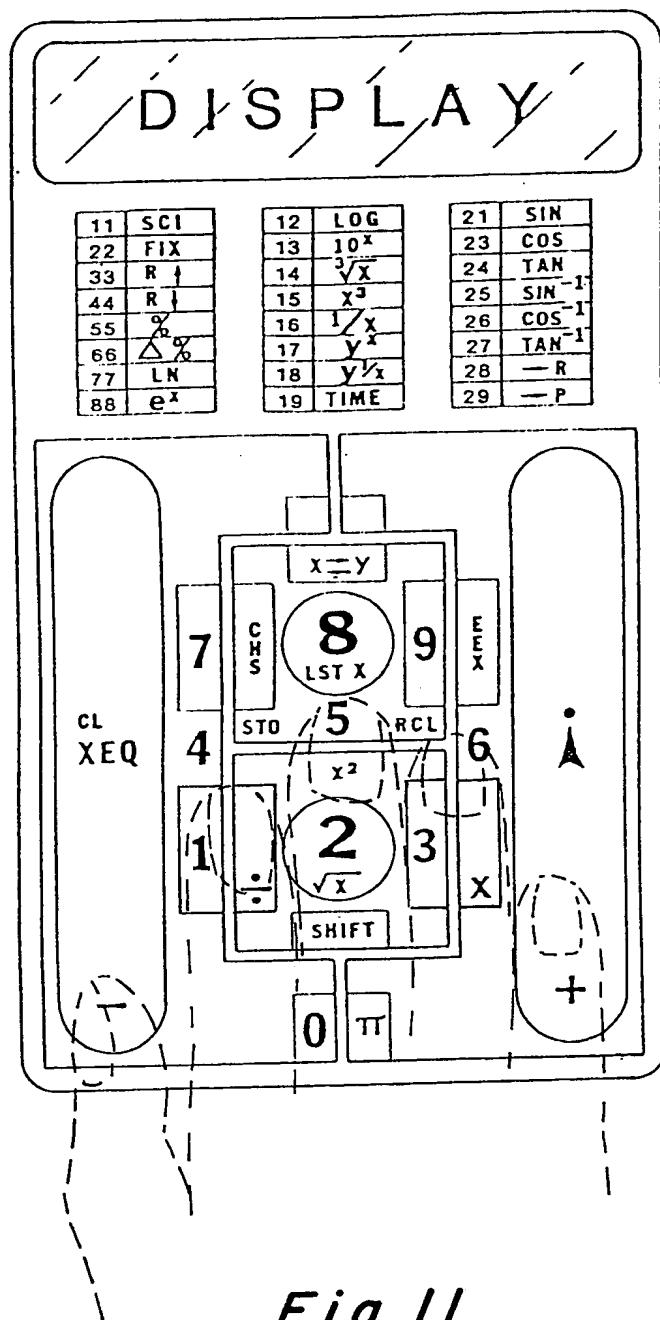


Fig. 11

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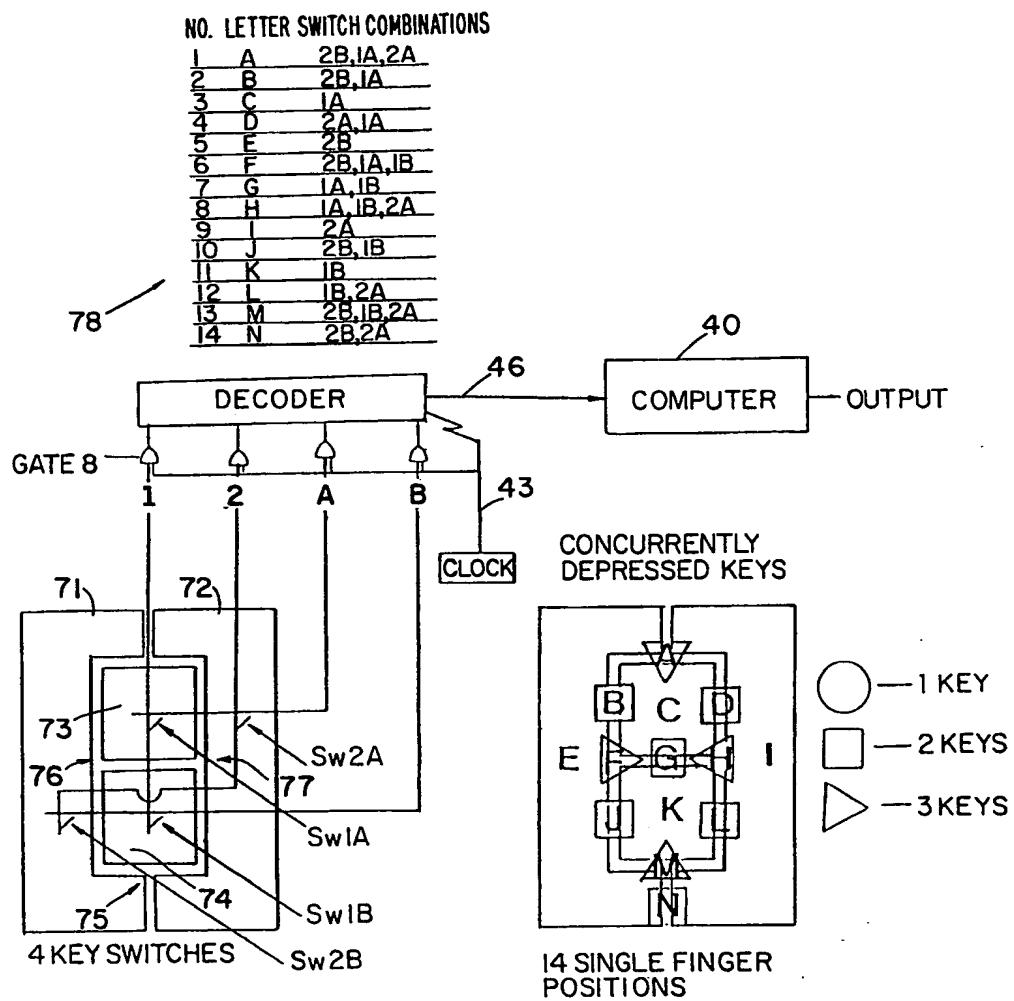
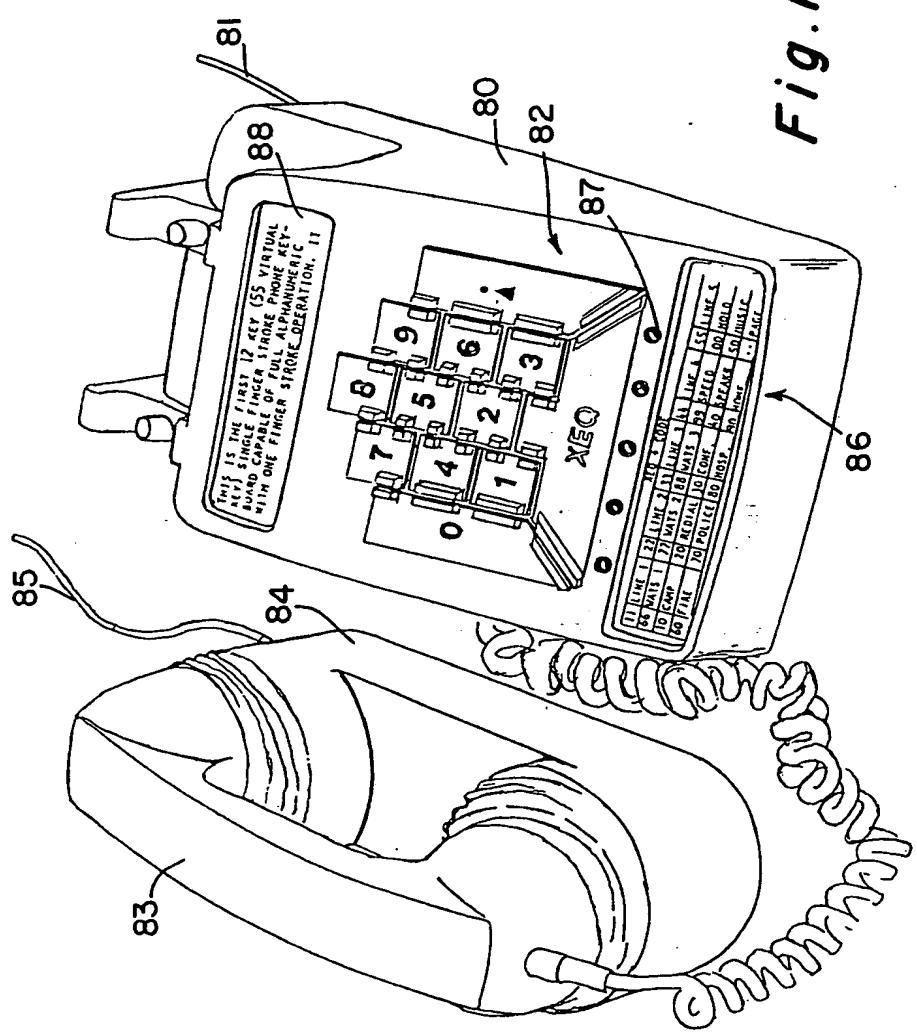


Fig.12

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KEYS
 ACTIVATED
 — 1
 — 3
 — 2

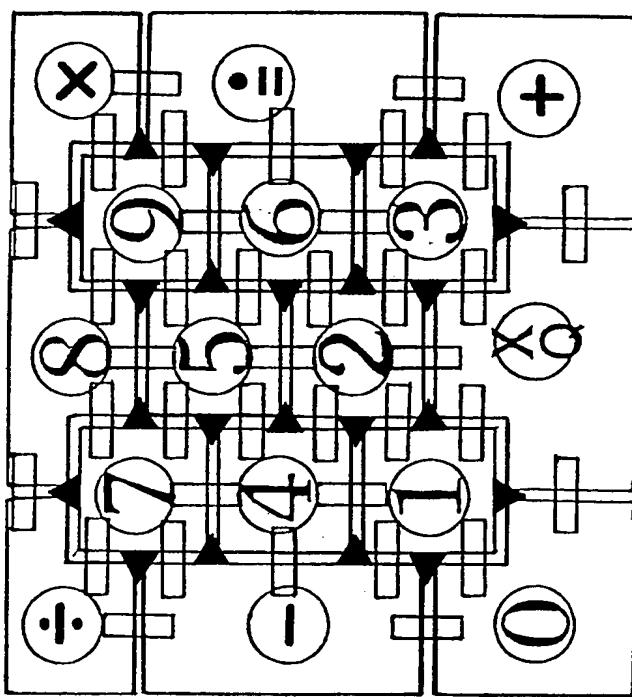


Fig. 14

SPECIFICATION

Touch type computer keyboards

5 This invention relates to keyboards and more particularly it relates to touch type keyboards operable by one hand offering a large number of key selection choices such as required for alphanumeric computer applications.

10 At this advanced stage of the development of the computer art commercially available chips provide systems capable of many types of functional operations and full alphanumeric data processing capabilities. The keyboard computer input art has been developed to interface with computer systems. Thus, for example, U.S. Patent 3892958—C. C. Tung provides a multiple key keyboard with means for changing the mode of computer operation to adapt the keyboard to three different sets of functions, all illustrated on

15 keyboard indicia and with the three modes and corresponding key functions differentiated by indicia of three different colors, such as black, orange and blue. Also other techniques are known in the prior art for producing more functions per key in a keyboard

20 assembly in an attempt to interface with more of the computer functions by a keyboard of modest size. Exemplary are: U.S. Patent 4042777—F. C. Bequaert et al., Aug. 16, 1977 which permits chords of several simultaneously actuated keys to the supplement

25 individual keystrokes and thus expand the communication interface capabilities of a keyboard with a computer. German Publication DE 2924515—S. Pretzsch published Jan. 15, 1981 provides for selection of more than one of several adjacent keys

30 simultaneously by a single fingerstroke to increase the number of selections on a keyboard; and U.S. Patent 4344069—E. S. Prame, Aug. 10, 1982 provides a single handed keyboard with alphanumeric capabilities by selecting a sequence of keystrokes for alpha

35 characters.

40 However, none of these keyboards are operable to enter comprehensive data and instructions in a computer in the touch mode similar to that of touch typewriters, where data may be entered quickly and accurately by a typist with little effort or explicit choice decisions after becoming acquainted with the keyboard layout. In particular, it is not feasible in the prior art to use a keyboard of so few keys that it can be operated by a single hand to enter a comprehensive set of

45 different data and instructions, for example a hundred and fifty different selectable choices that provides full alphanumeric data operation as well as full computer control and access. Furthermore, there have not been significant developments in the art, other than the

50 above-mentioned patent 4042777, that relate to the interface of a one hand operated keyboard and a computer in such a way that touch typing can proceed. There have been no known such keyboard system developed with the particular objects of one-handed

55 computer entry with rapidity and elimination of the source of errors from such manual actions as hitting a wrong key, hitting extra keys, resting the fingers on a wrong set position or counting a sequence of numbered key actuations for an entry. No particular

60 attention has been given to operator finger fatigue or

65 avoidance of unnatural finger positions and reach.

It is therefore an objective of this invention to improve the state of the art by resolving some of these problems and providing improved keyboard systems not heretofore available in the art. Other objects, features and advantages of the invention will be found throughout the following description, the drawings and the claims.

A keyboard for use by one hand and adapted for entry of a large number of selections including those for alphanumeric data processing and a large range of computer operation commands has ten keys providing direct entry of numerical digits plus a decimal key and at least one auxiliary command key. A preferable arrangement uses twelve keys in a layout pattern particularly adapted for one hand selection by the fingers on either hand. The system, by means of "virtual" keys selectable by simultaneous actuation of two or more individual keys, provides typically at least one hundred and fifty selections with full alphanumeric data processing capability, wherein each entry requires a single fingerstroke. The keyboard is particularly adapted to the touch typing mode and provides an interaction of keys, layout, functional selection, system, etc. which avoids those mental requirements of choice on the part of an operator that lead to errors. Also, the system includes features which prevent errors due to physical fatigue or motion, particularly of the sort where unnatural motion, reach or position is required.

Thus, the keyboard has five columns coinciding with the natural position of the five fingers on a hand. The keys in adjacent columns are offset to permit the hand to use the board with the fingers in natural position. That is the middle finger is longer than the ring finger and index finger, and the thumb and little finger are the shortest. With this keyboard therefore the keys are offset to coincide with this natural finger length condition.

100 To produce the many selection choices of entry such as more than one hundred and fifty, the keyboard operates in at least three modes, for example, each providing direct entry with a single fingerstroke of fifty or more selections. Thus, a single finger selects either a single key or a plurality of keys appearing adjacent each other and sharing common sides on the keyboard layout. The offset keys further provides a wider range of keystroke choices than would otherwise be available.

105 To facilitate the touch system of key selection, groups of keys are provided with a single finger selection position not interfering with any other finger selection position by means of groups of associated discrete raised ridge portions vertically projected from the keyboard surface at the lines of separation of the adjacent keys. To extend the number of groupings possible several of the outermost keys are shaped to span more than one of the other keys in both the key columns and across a plurality of the columns.

110 In the drawings:

Figure 1 is a plan view of a twelve key keyboard assembly embodying a preferred embodiment of this invention;

Figure 2 is a sectional view taken along the lines 2-2 of Figure 1 showing the elevational differences of the

key surfaces configured for selection of a plurality of side-by-side keys for concurrent actuation by the stroke of a single finger;
 Figure 3 is a sectional view taken along the lines 3-3
 5 of Figure 1 showing the raised portions 18 and 19 for concurrent actuation by the stroke of a single finger to provide the shift function;
 Figure 4 is a sectional view taken along the lines 4-4 of Figure 1 showing the elevational differences of the
 10 key surfaces configured for selection of a plurality of upper-by-lower keys for concurrent actuation by the stroke of a single finger as illustrated;
 Figure 4a is a sketch of the right hand identifying the finger nomenclature used throughout this patent
 15 application;
 Figure 5 is a block system diagram of a computer system embodying the invention;
 Figures 6 and 7 are examples of how the keyboard can be incorporated into computing instruments and
 20 show the approximate real scale of the keyboard in relation to well known components of the instruments;
 Figures 8 and 9 are provided to show that the raised portions can have various shapes as dictated by
 25 ergonomic considerations;
 Figure 10 is provided to show a 9 key embodiment of the invention providing 35 single finger stroke positions;
 Figure 11 is a 4-key embodiment of the invention
 30 providing 14 single fingerstroke positions and is the minimum desirable configuration of the invention;
 Figure 12 is a schematic system diagram of a four-key, fourteen selection keyboard configuration operable with a 2 x 2 four wire switching matrix;
 35 Figure 13 is a perspective view of a telephone incorporating the advances of this invention for telephone system applications; and
 Figure 14 is a plan view layout of a sixteen key keyboard embodiment.
 40 As may be seen in the plan view of Figure 1, a twelve key keyboard layout is afforded that provides a plurality in the order of fifty or more data or function selections as noted by the indicia. Thus, the twelve basic keys 15, 16, 17, etc. provide for the numeric digit
 45 entries as well as a pair of command keys for executing functions selected (15) or entering data into the computer (16). The latter key 16 may also be a decimal point key on a first stroke and a data entry key on the second stroke.
 50 All the other entries are made from "virtual" keys by the concurrent selection of two or more of the twelve keys. This is made feasible in the touch mode for operation with a single hand, either right or left, using a single finger for stroking each entry in a well defined
 55 fingerstroke position easily accessible for the touch system. Thus groups of ridged key portions or bars 18, 19 or 20, 21 etc. are found throughout the keyboard, as are profiled in Figures 2, 3 and 4.
 To some extent the shape and size of the raised
 60 portions are controlled to permit the labeling of the characters used. Touch tests using dummy models among a limited number of people indicate a divergence in preference as to the shape, height, length and touch area of the raised portions extending from the
 65 key-switch surfaces. Therefore I do not limit myself to

any particular embodiment. Any changes that aid the user in actuating the keys singly or in multiples with single fingerstroke is believed to be within the scope of the invention. To illustrate that changes can be
 70 made while maintaining workability of the invention the ridge shapes of Figures 8 and 9 may be observed. Special shapes may be required for persons with long fingernails.
 It is seen that for every indicia position, noting the
 75 function of the key stroke made at that location, is a finger selection spot where only one entry can be made. The single keys are actuated at the circles 22 or ovals 23. the "virtual" keys comprising multiple key groups are actuated at the bar groupings such as the
 80 asterisk (*) at 20, 21 or the shift at 18, 19. The fingers thus in the touch mode can engage only one entry position at a time. The digit 6 for example is recessed within the raised portions 24, 25, 26 which all move together and confine the finger to spot 6 to actuate
 85 only key 27. Conversely the finger at the asterisk 20, 21 engages the two raised bars only and actuate both keys 16 and 28, etc. The notation X between the 6 and 3 locates a fingerstroke position for operating the two keys 27 and 28 concurrently. The bars are not
 90 necessary (but may prove useful) at all such intersections, particularly since the finger touch senses a crack between two keys.
 The notation ? is located between two bar pairs 20, 21 and 25, 30 and identifies a fingerstroke position for
 95 actuating three keys 16, 27, 28 simultaneously by means of four bars 20, 21, 25, 30. Note that elongated columnar key 16 spans several (3, 6, 9) columnar keys to give a variety of combinations selectable at three bar pair locations 20, 21 and 25, 30 and 31, 32.
 100 Similarly elongated cross spanning key 15 spans the five columns to provide five two key combinations. Note also that by the vertical row offset of the keys in the three center columns of keys a choice of two different keys in an adjacent column can be made in
 105 two key pairings such as the "M" and "K" and a set of three keys will result with a four bar selection as at V or Y.
 It is seen therefore that enough selections (more than 50) can easily be made with twelve keys to give
 110 about the same capacity as a standard typewriter keyboard. This is noteworthy since it can replace a standard telephone switch panel (which normally uses 12 keys) and provide alphanumeric capability, requiring only one hand access.
 115 The tactile identification of different single finger selection spots by bars, keys centers, line junctions, etc. herein considerably enhances the ability to touch type without errors because tactile feedback through the fingers indicates the selection being made.
 120 Furthermore errors are caused by fatigue, unnatural and extensive reach and other such factors. Many of these error sources are overcome herein by the keyboard configuration and layout.
 Consider the shape of a human hand, for example.
 125 The middle finger is long, the ring and index finger of intermediate length and the thumb and little fingers are the shortest. As seen clearly in Figure 4a, the offset key layout thus fits the human hand to rest it naturally, reducing fatigue or unnatural reach, etc. With only
 130 twelve keys the hand rest position is always evident

and is more easily identified by tactile feedback.

Operational advantage and accuracy of this keyboard is also evidenced by the single fingerstroke, single finger selection of every entry. Thus, the operator need not think about chording or sequencing and is only required to do the simplest possible thing, select a finger spot and stroke it. Thus, a simple, comprehensive keyboard system is afforded enabling lower error touch type input into electronic data processing or computer systems 40 as set forth in Figure 5.

In order to better match the keyboard to the multiple functions available in modern computers 40, the mode of operation can be changed, again by a single fingerstroke, to produce a different set of fifty or more functions to the keys. Thus as seen by the small \otimes and \odot notation in the 8 key (22) three sets of indicia are located on the keyboard. \otimes indicia may be orange and \odot blue for example to simply show the mode set in color coded form. Thus, on the bar pairs 20 and 21 (Figure 1) color coded indicia will denote the selection of functions and data available and indicate by color code which mode selection key is required. For example if an "&" is required the shift key bar pair 18 and 19 (\odot —denoted for some keys as \odot) must be stroked prior to the stroking of bar pair 20 and 21. If the special characters or functions such as * denoted by \otimes are required, the stroking of bar pair 20 and 21 must be preceded by the XEQ key. This shifting operation is a conventional one being practiced every day by typists and therefore has proven to be for many years a quite acceptable ergonomic procedure.

The twelve keys may be wired conventionally as shown in Figure 5 in a four by three matrix pattern 42 designated on block keyboard 41, ample to convey the unique codes for each of the designated choices available. By conventional clocked code conversion 43, the data entry and functional command processing can be directed upon send signal 44 to computer 40 via 46. The computer output 45 may be directed to suitable devices such as alphanumeric displays, CRT tubes, printers, plotters, etc.

The nine keys for digits 1 to 9 in the three centermost columns, as shown in Figure 1, are of substantially the same size and shape to adapt to finger selection to operate the separate keys and concurrently operated keys without interference. Also the spacing of the keys is substantially the same as that used as industry "standard" on most typewriters and adding machines 50 which to some extent will reduce the time required for an operator to become proficient in the touch operation of the system. Even those users who do not become proficient with the touch system, such as many executives today, will find the hunt and peck 55 method far easier to use since the keyboard field over which they must hunt is so much smaller than the hunting area presented by the modern computer keyboard which can often have more than 100 keys. Also, the advantage of symmetry are provided for 60 either right or left hand operation, and an improved keyboard system is made available for accurate and rapid touch type operation. Note the spacing of finger touch bars in Figure 4, wherein the finger can bridge two vertically separated bar groups that can be 65 selected individually when desired. Also note that the

finger can feel whether it is in a proper key position at various positions on the keyboard, further contributing to error free selections.

Note in consideration of Figures 1 and 4 together 70 that raised finger contact structure defining fingerstroke position have portions common to the sides of two adjacent keys, such as . and : or = and \circ . This permits individual finger selection of the two adjacent keys 1, XEQ or 1, 2, etc. to permit a single finger to bridge a pair of the raised finger contact positions.

Accordingly, either one pair or both pairs of the key ridges straddling the common intersection of three and only three keys can be actuated by a single fingerstroke, thereby increasing the number of available unique fingerstroke selections. That is, either keys 1, 2 or keys 1, XEQ or keys 1, 2, XEQ can be selectively actuated by a single fingerstroke, and similarly this can occur at all the sixteen junctions of 3 and only 3 keys provided in this embodiment.

85 Because this 12 key keyboard occupies so much less space than a conventional keyboard and because of its symmetry of design, it would be possible to have two such keyboards feeding a single computer whereby the speed of entry into the computer could still further 90 be enhanced since the operator could make use of both hands instead of only one. Also this keyboard is fully compatible with a telephone to provide complete communication capabilities.

Figure 6 shows an embodiment of the keyboard 95 with the keyboard coupled with a printer as utility means and adapted to work with a data processing system in various modes, such as typing, adding, plotting, teletype communication, arithmetic and programming modes. This is readily attainable at the present state of the art by combining the computer operations of Figure 5 with display panel 50, printer 51 and switch selection 52, 53 options.

Note also the series of hinged charts 54 tabbed for identification, wherein a sequence of two keystrokes 105 10, 11, etc. are assigned corresponding functions such as program steps when the switches select the program steps in the program mode. This increases the capacity of the keyboard to use the full capability of modern computer chips with hundreds of possible 110 functions with only twelve keys. Thus, a hybrid mode of operation is employed using the single stroke selections for the errorless typing input feature and expanding capabilities for a simplified programming catalog of a diverse computer language that is 115 self-explanatory and fully self-complete without reference to an instruction manual.

As seen from the two decimal digit numbers in columns 56 of charts 54, the internally programmed subroutines of a computer such as addition, square 120 root, or various built-in program subroutines identified conventionally by a program language word of variable length is identified by a fixed number X (in this case 2) of numerical or other digits identifying the sequence of key strokes necessary in a two and only 125 two step function selection step. If the mode is program entry (PGM) as selected by switch 53 then a considerable saving of programming time and strokes are saved over conventional variable digit English program words. Clearly the Fortran Statements INTE- 130 GER, RETURN, PRINT, CONTINUE, etc. each could be

entered by two strokes each at a considerable saving of time and with less chance for error.

This feature unexpectedly therefore can save a considerable amount of programming time over 5 today's conventional program languages such as Fortran and Basic, because for every program step only two keys need be operated. Yet the corresponding familiar English language or computer language steps may be written into the spaces 55 if desired for 10 the convenience of those familiar with a particular language. Because of the plurality of hinged cards 54, several different modes of operation may be provided and catalogued. Thus, both Fortran and Basic terminology could be related to the two-key sequence selection on different card sets 54. If three keys are selected in sequence, more unique entries are selectable (1000 with numeric numbers alone). If all the (55) keys including virtual are used with two strokes almost three thousand unique selections are available.

20 Thus by employment of a routine operational step such as limiting the significant decimal digits to two, the functional entries are made by a sequence limited to two (or more) key strokes identified in columns 56 for achieving the displayed functions to be written into 25 blank spaces 55 for immediate access as a catalog of the available functions. It is estimated that a program may be entered in the program mode in this manner with less than one-third the number of key strokes, with a corresponding time saving.

30 In Figure 7, the multi-purpose printer-keyboard system is smaller in size and provides a very efficient pocket size typewriter - computer - communication medium with all the foregoing advantages of the novel keyboard system.

35 Figure 10 is a simpler keyboard layout with only nine keys, thus affording the advantage of operation with a 3×3 wire matrix selection network. Note that there are 35 separate fingerstroke positions so that full alphanumeric capability similar to typewriter 40 keyboards is afforded with all the other keyboard advantages hereinbefore discussed. Note that a field of substantially square keys as in Figure 1 is arranged in three adjacent columns with the center column keys offset from the keys in the outer two columns to 45 provide a plurality of nine three and only three key intersection positions.

A minimal number of keys for attaining numeric instructions to calculators, computers and the like is four as shown in the embodiment of Figure 11. The 50 finger rest feature and offset key-columnar arrangement here offers the advantages of the prior versions as seen by the phantom hand superimposed over the keyboard to permit touch operation by a single hand in comfortable position. With the four keys and ten 55 virtual keys, fourteen selections are provided in a single mode with a live keyboard. In the three modes hereinbefore described (one preceded by X, one preceded by S and one direct) 52 selections are feasible. This embodiment also has the program chart 60 feature so that for example XEQ.21 will program or select the sine function, etc. With 14 direct selections at the corresponding stations A, B, C, etc., (Figure 12) as many as 183 separate functions can be programmed with a two-key sequence. thus, the hybrid system 65 of using a single fingerstroke per entry on typing and data input and using a two (multiple) fingerstroke per selection function in a programming mode significantly extends the power of the keyboard. It is certainly even more unexpected than that only four 70 keys could produce 14 selections that a simple two-step stroke will permit the four keys to select $183 + 52 = 235$ unique entries in the three mode live + \otimes + \odot keyboard operation.

As may be seen by reference to Figure 12, this 75 surprising expanded keyboard power is in part achieved by the teaching of this invention that the keyboard pattern hereinbefore discussed in common with this embodiment has groups of at least four keys 71, 72, 73, 74 sharing adjacent sides arranged in a 80 geometrical pattern with at least two common intersections 75, 76, 77 of sets of three adjacent keys having all three keys meeting at a common intersection or junction of only three keys in a position accessible to a single finger overlapping the intersection 85 to actuate all three keys simultaneously with a single fingerstroke (A, M, F, H). This provides along with the accompanying single keys (I, E, C, K) and dual side-by-side (B, D, G, J, L, N) with corresponding finger access positions the fourteen direct selections 90 available for a single fingerstroke. In the conventional four corner intersection of non-offset keys, far fewer selections could be made with a given number of keys. Also in a two by two matrix, only three combinations of three keys are available uniquely even if a finger 95 could seek out only three keys together. Thus, only 9 combinations are possible in that mode. For example, Pretzsches, German 924515, gets nine selections from four keys conventionally arranged.

Furthermore, it is surprising that a four wire 100 communication channel (1, 2, A, B) will carry uniquely the full range capacity (253 as above shown) of unique entries available from the four keys. The chart 78 lays out the truth chart codes for the four lines 1, 2, A and B. Note that the key pattern is also non-conventional and 105 contributes unexpectedly to a reduction in the number of channels required for communication in that the combinations of threes are used (A, F, H, M). This powerful expansion of key power afforded by this invention is correspondingly amplified with the greater number of keys in the preferred embodiment of 110 Figure 1. The four key embodiment is preferred for such applications as numerical or industrial control systems, coded electronic locks and the like, particularly if wiring is required and fewer wires are 115 advantageous.

Keys 73 and 74 are connected to matrix line 1, keys 71 and 72 to matrix line 2, keys 72 and 73 to matrix line A and keys 71 and 74 to matrix line B to give the fourteen unique combinations shown on truth table 78. Thus 120 four communication channels A, B, 1, 2 can handle all the combinations and entries of this minimal four key version of the invention.

A 2×2 matrix matrix of wires connects the keyboard keys as a communication channel to means responsive to key actuation such as computer 40. Each key intercouples two of the matrix wires by actuation of the key, by such means as mechanical switches or equivalents thereof to produce by a single fingerstroke in a single live key operation mode fourteen 125 unique manual selections.

The versatility and applicability of the keyboard system afforded by this invention is exemplified by the embodiment seen in Figure 13. Thus, a desk cradle type telephone 80 of conventional shape has a 5 telephone line connection 81 and the keyboard 82 afforded by this invention. If desired other devices may be acoustically coupled into handset 83 through modem unit 84 from a communicator coupled to cable 85. Also as provided by this invention, the panel 86 outlines a two step switching selection sequence in a program mode which may be established by the execute key (XEQ) with a typical array of functions. Line lights 87 may be provided, and any operating data and messages may show on electronic display 15 88. Thus a most simple "PBX" type switchboard with full communications and intercomputer connection capabilities is provided and is adaptable for use over the telephone system using conventional tone and/or digital communication techniques. The local switch- 20 board selections are of the coded type hereinbefore discussed in more detail.

Note that the same keyboard can in this way unexpectedly eliminate the extra keys in conventional telephone switching systems provided for the switch- 25 board selections. That is the keyboard does both the dialing function and the switching function and furthermore expands communications from numeric to alphanumeric plus.

In Figure 14 a field of sixteen keys is shown 30 maximizing the three key junctions to provide twenty-two such combinations. A sixteen key field is convenient for use of a 4 x 4 wire matrix. In the illustrated embodiment the keys are shaped to produce seventy-five switching combinations of the single fingerstroke 35 choices of one, two or three concurrently operated keys respectively outlined by the designated coded indicia.

For calculating all possible selections from 16 keys (X) taken 3 (N) at a time in different combinations, the 40 formula $X \cdot (X-1)^{N-1} + 1$ may be used, taking into account that one key (XQ) is used as a common key similar to a shift key. As seen from the table which follows therefore in this embodiment 3601 extra 45 selections of computer functions, addresses, catalog items, etc. could be indexed by the basic sixteen keys operable in a successive key selection mode (of three) such as illustrated in the switching charts of Figures 6, 11 and 13.

While certain preferred embodiments are explicitly 50 shown herein other combinations of keys and key layout geometry are possible. Thus, the following table charts the number of functions (F) selectable from keyboard arrays of the numbers of keys (X) between four and fifty-five for sequences (N) of two, 55 three and four successive strokes.

$$F = X \cdot (X-1)^{N-1} + 1$$

| | | | |
|----------------|--------------------|----------------------|----------------------|
| $X = 4$ | $X = 17$ | $X = 30$ | $X = 43$ |
| $n=2$ F=13 | $n=2$ F=27 | $n=2$ F=57 | $n=2$ F=1,87 |
| $n=3$ F=37 | $n=3$ F=64,233 | $n=3$ F=125,231 | $n=3$ F=25,83 |
| $n=4$ F=109 | $n=4$ F=218,623 | $n=4$ F=721,671 | $n=4$ F=3,165,785 |
| <hr/> | | | |
| $X = 5$ | $X = 18$ | $X = 31$ | $X = 44$ |
| $n=2$ F=21 | $n=2$ F=37 | $n=2$ F=51 | $n=2$ F=1,83 |
| $n=3$ F=41 | $n=3$ F=64,133 | $n=3$ F=127,81 | $n=3$ F=21,237 |
| $n=4$ F=121 | $n=4$ F=218,133 | $n=4$ F=721,801 | $n=4$ F=3,193,349 |
| <hr/> | | | |
| $X = 6$ | $X = 19$ | $X = 32$ | $X = 45$ |
| $n=2$ F=31 | $n=2$ F=43 | $n=2$ F=53 | $n=2$ F=1,81 |
| $n=3$ F=51 | $n=3$ F=64,157 | $n=3$ F=131,113 | $n=3$ F=27,121 |
| $n=4$ F=751 | $n=4$ F=119,697 | $n=4$ F=333,113 | $n=4$ F=63,231 |
| <hr/> | | | |
| $X = 7$ | $X = 20$ | $X = 33$ | $X = 46$ |
| $n=2$ F=43 | $n=2$ F=51 | $n=2$ F=57 | $n=2$ F=2,471 |
| $n=3$ F=63 | $n=3$ F=71,121 | $n=3$ F=131,71 | $n=3$ F=31,151 |
| $n=4$ F=123 | $n=4$ F=17,101 | $n=4$ F=1,811,145 | $n=4$ F=4,191,751 |
| <hr/> | | | |
| $X = 8$ | $X = 21$ | $X = 34$ | $X = 47$ |
| $n=2$ F=57 | $n=2$ F=42 | $n=2$ F=1,123 | $n=2$ F=2,103 |
| $n=3$ F=77 | $n=3$ F=81,101 | $n=3$ F=17,107 | $n=3$ F=59,103 |
| $n=4$ F=243 | $n=4$ F=14,101 | $n=4$ F=1,221,153 | $n=4$ F=4,574,713 |
| <hr/> | | | |
| $X = 9$ | $X = 22$ | $X = 35$ | $X = 48$ |
| $n=2$ F=73 | $n=2$ F=43 | $n=2$ F=1,131 | $n=2$ F=2,107 |
| $n=3$ F=97 | $n=3$ F=111,703 | $n=3$ F=16,111 | $n=3$ F=16,413 |
| $n=4$ F=273 | $n=4$ F=233,703 | $n=4$ F=1,375,411 | $n=4$ F=4,191,585 |
| <hr/> | | | |
| $X = 10$ | $X = 23$ | $X = 36$ | $X = 49$ |
| $n=2$ F=91 | $n=2$ F=51 | $n=2$ F=1,151 | $n=2$ F=2,351 |
| $n=3$ F=111 | $n=3$ F=11,133 | $n=3$ F=14,111 | $n=3$ F=112,897 |
| $n=4$ F=271 | $n=4$ F=244,195 | $n=4$ F=1,501,511 | $n=4$ F=5,419,885 |
| <hr/> | | | |
| $X = 11$ | $X = 24$ | $X = 37$ | $X = 50$ |
| $n=2$ F=111 | $n=2$ F=533 | $n=2$ F=1,133 | $n=2$ F=2,151 |
| $n=3$ F=131 | $n=3$ F=12,657 | $n=3$ F=17,153 | $n=3$ F=126,851 |
| $n=4$ F=211 | $n=4$ F=232,659 | $n=4$ F=1,726,273 | $n=4$ F=5,882,451 |
| <hr/> | | | |
| $X = 12$ | $X = 25$ | $X = 38$ | $X = 51$ |
| $n=2$ F=131 | $n=2$ F=61 | $n=2$ F=1,167 | $n=2$ F=2,351 |
| $n=3$ F=151 | $n=3$ F=14,101 | $n=3$ F=22,623 | $n=3$ F=127,511 |
| $n=4$ F=231 | $n=4$ F=151,611 | $n=4$ F=1,376,613 | $n=4$ F=5,375,411 |
| <hr/> | | | |
| $X = 13$ | $X = 26$ | $X = 39$ | $X = 52$ |
| $n=2$ F=157 | $n=2$ F=63 | $n=2$ F=1,163 | $n=2$ F=2,151 |
| $n=3$ F=177 | $n=3$ F=16,231 | $n=3$ F=24,231 | $n=3$ F=125,231 |
| $n=4$ F=223 | $n=4$ F=22,231 | $n=4$ F=2,148,665 | $n=4$ F=6,897,853 |
| <hr/> | | | |
| $X = 14$ | $X = 27$ | $X = 40$ | $X = 53$ |
| $n=2$ F=183 | $n=2$ F=70 | $n=2$ F=1,161 | $n=2$ F=2,371 |
| $n=3$ F=203 | $n=3$ F=18,233 | $n=3$ F=26,231 | $n=3$ F=143,313 |
| $n=4$ F=283 | $n=4$ F=47,233 | $n=4$ F=2,172,761 | $n=4$ F=7,432,225 |
| <hr/> | | | |
| $X = 15$ | $X = 28$ | $X = 41$ | $X = 54$ |
| $n=2$ F=211 | $n=2$ F=77 | $n=2$ F=1,161 | $n=2$ F=2,461 |
| $n=3$ F=231 | $n=3$ F=21,123 | $n=3$ F=35,641 | $n=3$ F=151,657 |
| $n=4$ F=311 | $n=4$ F=31,123 | $n=4$ F=2,621,681 | $n=4$ F=8,631,351 |
| <hr/> | | | |
| $X = 16$ | $X = 29$ | $X = 42$ | $X = 55$ |
| $n=2$ F=241 | $n=2$ F=813 | $n=2$ F=1,171 | $n=2$ F=2,471 |
| $n=3$ F=261 | $n=3$ F=22,737 | $n=3$ F=37,641 | $n=3$ F=161,281 |
| $n=4$ F=341 | $n=4$ F=53,641 | $n=4$ F=2,631,681 | $n=4$ F=8,641,351 |

It is therefore clear that this invention provides a novel keyboard input interface operable as a manual input device to a data processing system with various advantages including (1) more entries per key, (2) fewer communication channels per entry, (3) natural fit for a typist's hand, (4) single-finger single-stroke single-hand entry selection affording fast error free entry of alphanumeric information with typically twelve keys, (5) tactical feel for right finger positions at each entry, (6) full compatibility with computer, typewriting, telephone and communication link operations, (6) visible catalog of data and functions entered by the keys, (7) faster program entry with fewer strokes, (8) optimum size for pocket instruments and telephones, etc. The state of the art has been unexpectedly improved by a simplification that produces greater versatility and key power saving time and equipment. Therefore, those features of novelty believed descriptive of the spirit and nature of the invention are defined with particularity in the claims.

CLAIMS

1. A keyboard system characterized by a set of at least four keys of a geometric shape sharing adjacent sides and arranged in an array with at least two common junctions where three keys meet at a common intersection of only three keys in a position accessible to a single finger overlapping the three keys at said intersections to actuate all three keys concurrently with a single fingerstroke.
2. A keyboard system as defined in Claim 1 coupled as manual input means to operate a data processing system for input of data and instructions, wherein the keyboard is coupled to select different modes of operation in response to a sequence of at least two successive keystrokes which uniquely define each available mode of operation.
3. A keyboard system as defined in Claim 2 wherein the sequence of successive keystrokes to define said different modes of operation consist of a fixed number X of keystrokes.
4. A keyboard system as defined in Claim 3 wherein said data processing system is a programmable computer system adapted to receive instructions by means of program steps defined by program words constituted by code words entered by said fixed number X of keystrokes.
5. A keyboard system as defined in Claim 2 wherein the keyboard is in a housing containing therealongside a chart with graphic indicia thereon designating a plurality of the entries available with different keystroke sequence selections.
6. A keyboard system as defined in Claim 1 provided with raised finger contact ridges disposed on adjacent keys to define fingerstroke positions for concurrent actuation of predetermined sets each having a plurality of keys with a single fingerstroke.
7. A keyboard system as defined in Claim 1 having at least nine keys arranged in an array of three vertical parallel adjacent columns of at least three keys, wherein the keys in the centermost column are offset vertically from the keys in the outer two columns to form a plurality of said intersections and to conform the key locations to the natural offset position of the three middle fingers of the human hand.

8. A keyboard system as defined in Claim 7 including a set of three further keys each overlapping at least two keys and confronting three sides of the nine key array to form a twelve key keyboard.
- 70 providing a plurality of more than fifty unique combinations of keys with single fingerstrokes.
9. A keyboard system as defined in Claim 1 having four keys in a side-by-side array geometrically shaped to provide at least thirteen fingerstroke positions for actuating unique combinations of sets of one to three of the keys with a single fingerstroke.
- 75 10. A keyboard system as defined in Claim 1 having a keyboard surface structured to produce at least three different kinds of finger selection zones distinguishable by tactical feel identify predetermined keystroke positions.
- 80 11. A keyboard system as defined in Claim 1 coupled to utility means by a multiplicity of communication channels coupling the keys to actuate the utility means as a function of unique combinations of said channels concurrently selectable by actuation of corresponding sets of keys with single fingerstrokes.
- 85 12. A keyboard system as defined in Claim 11 wherein the utility means comprises a telephone system, and twelve said keys are provided to enter numerical digits by single fingerstroke selection of individual ones of the twelve keys.
- 90 13. A keyboard system as defined in Claim 12 including means for alphabetic communication by entry of alphabetic characters with single fingerstroke combinations of two or three concurrently actuated keys.
- 95 14. A keyboard system as defined in Claim 12 including mode selection means for designating 100 different operating modes in response to a sequence of at least two successive keystrokes of unique keyboard key set combinations selectable by said single fingerstrokes.
- 105 15. A keyboard system as defined in Claim 1 having at least eight keys providing enough unique key set selections from said single fingerstrokes for defining a set of alphanumeric characters connected to a printer.
- 110 16. A keyboard as defined in Claim 1 with visual indicia markings on the keyboard graphically identifying a set of markings numbering more than three times the number of keys identifying thereby different ones of the unique key combination selections actuated by single fingerstrokes.
- 115 17. A keyboard system as defined in Claim 1 coupled to a system operable in a selectable mixed hybrid mode from said keyboard with means establishing one mode in response to the concurrent actuations of said sets of combinations of keys with a 120 single fingerstroke and another mode in response to the successive actuation of at least two single fingerstroke entries.
- 125 18. A keyboard system characterized by a keyboard providing a plurality of key selections available for manual entry of information by means of a series of single fingerstrokes, a computer system coupled with said keyboard for receiving manually entered data and instructions, means for establishing a program mode of operation for manually entering 130 instructions into the computer system, and instruc-

tion entry means operable in the program mode to enter specific instructions in a set of instructions individually in response to a constant number n of sequential keystrokes each, a graphic chart identifying said set of instructions visually together with the sequential keystrokes necessary for each individual entry at the keyboard location.

19. A keyboard system substantially as hereinbefore described with reference to the accompanying drawings.

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